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Title: The Aberrant Central Incisor

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The Aberrant Central Incisor

Abstract

The maxillary permanent central incisor develops early in life and forms part of an aesthetic smile. Disruption of the formation or eruption of the permanent central incisor has multiple aetiological factors. Treatment options depend to some extent on the cause of failure of eruption of the central incisor. Generally the earlier treatment is provided, the higher the likelihood of success and the less the complexity. This article gives an overview of the possible aetiology and treatment of the aberrant central incisor.

Clinical relevance

Unerupted central incisors are a clinical complication that occurs commonly in orthodontic practice. The clinician should be aware of the aetiology and possible treatment options.

Objectives statement

The reader should be aware of the aetiology and treatment of unerupted central incisors

Development of the maxillary central incisor

The maxillary central incisor commences its development in the 30th week *in utero*. Calcification begins 3 to 4 months post partum and the crown is usually complete by the age of 5 years. It is often the second maxillary permanent tooth to erupt, following the first permanent molars, roughly between the ages of 7 to 8 years. This is followed by eruption of the mandibular lateral and maxillary lateral incisors.

Eruption path

The follicle of the permanent central incisor forms palatal to the root apex of the deciduous predecessor and the eruptive path has a labial vector. As the mesio-distal width of the permanent tooth is greater than its predecessor, permanent maxillary central incisors by necessity erupt labially and therefore into a wider dental arch. This eruptive process results in resorption of the deciduous incisor root, under the influence of follicular cells [1].

If there is insufficient labial migration of the permanent tooth germ, physiological resorption of the primary root will not occur and the permanent tooth will erupt palatally. This deviation of the eruptive path may also result in distortion of root form, creating a dilaceration (altered crown root angulation).

Raising suspicions

The absence of a maxillary permanent central incisor in a patient aged over 9 years is unusual. Eruptive delay of greater than 6 months compared to the contralateral tooth, or disturbance in eruption sequence (eruption of lateral

incisors before central incisors) should raise suspicions, and certainly warrants further investigation. There may be several possible reasons for this central incisor not to erupt including, but not limited to:

Systemic Causes:

- Cleft lip and palate
- Cleidocranial dysplasia
- Generalised delay in development
- Gingival fibromatosis

Local Causes:

- Obstruction of the eruptive path of the central incisor:
    - Most often due to a supernumerary tooth/odontome [2]
    - Persistence of the primary tooth
- Early loss of the primary tooth causing:
    - Thickened gingival tissues
    - Space loss
- Dilaceration of the permanent central incisor
    - Traumatic (22%) or developmental (71%) [3]
- Ankylosis of the permanent central incisor
- Ectopic position of the central incisor
- Absence of the permanent central incisor
    - Due to previous trauma [4]. Up to 2% of 12 year olds have a missing central incisor as a result of trauma [5]

These causes will now be discussed in turn.

Systemic Causes

Cleft lip and palate and cleidocranial dysplasia are both associated with delayed eruption and an increased incidence of supernumerary teeth, especially in the region of the cleft [6]. Gingival fibromatosis is a condition characterised by progressive enlargement of the keratinised gingiva, providing greater resistance and difficulty for teeth to erupt normally [7].

Local Causes

1. Obstruction of the eruptive path of the central incisor

1.1 Supernumerary teeth

The most common cause for delayed eruption of a maxillary permanent central incisor is the presence of a supernumerary tooth in the eruptive path, usually a tuberculate type [2, 8]. These often lie palatal to the incisor (Figure 1) and develop as a fragmentation from the dental lamina [9] due to loss of function of the Sprouty genes (Spry2 & Srpy4) [10]. Unlike the tuberculate supernumerary, midline supernumeraries such as the mesiodens do not prevent the eruption of the central incisor, but can lead to a deflection from its normal path of eruption and the creation of a midline diastema (Figure 2). Occasionally a supplemental incisor can also lead to a deflection of the path of eruption of the central incisor as illustrated in Figure 3.

Figure 1 An OPG radiograph showing an unerupted upper left central incisor with a supernumerary overlying the tooth palatally and preventing the eruption of the central incisor

Figure 2 – Erupted midline supernumerary or mesiodens. Notice how it has displaced the upper left central incisor from its normal eruptive path, but has not prevented its eruption

Figure 3 – A supplemental upper incisor has caused the upper left central incisor to assume an ectopic path of eruption

1.2 Persistence of the primary tooth

Physiological resorption of primary teeth usually occurs as a coupled process between programmed resorption and repair under the influence of the overlying developing follicle. Failure of this process will result in retention of the primary tooth root and obstruction of the pre-emergent eruption of the permanent tooth germ. This can lead to a deviation of the crown with consequential dilaceration, a palatal eruption or just delayed eruption of the permanent central incisor. Failure of resorption is often of unknown cause, but it may potentially be due to traumatic insult. Alternatively, if a deciduous central incisor has itself been traumatised and become non vital, it may lead to the formation of a periapical granuloma or periapical cyst that may prevent resorption of the deciduous root and normal eruption of the permanent successor (Figure 4)

Figure 4 – Two previously traumatised deciduous upper central incisors have become non vital and are preventing the eruption of one permanent central incisor and deflecting the path of eruption of the other

Treatment in the case of obstruction

The vast majority of teeth will erupt following the removal of the obstruction, i.e. the supernumerary tooth or retained primary tooth [11, 12]. Adequate space provision is an important factor for the successful eruption of the permanent central incisor following removal of the obstruction [9]. Although the probability is high, there is no guarantee the permanent central incisor will erupt under its own volition. Traction may be required and placement of an attachment at the same time as obstruction removal may be prudent and reduce the need for a second anaesthetic [13, 14]. Care needs to be taken if an attachment is to be bonded to the unerupted tooth in order to ensure the tooth erupts through attached mucosa and consequently a good keratinised gingival margin is created (Figure

5). The earlier the treatment is performed, the higher the likelihood of successful outcome [15].

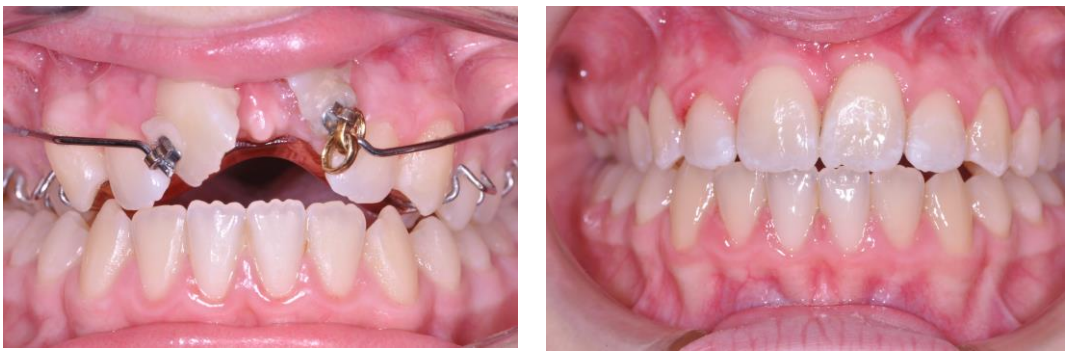

Figure 5 – Traction applied through the keratinised mucosa ensures a good gingival margin at completion of treatment

2. Early loss of the primary incisor

Early loss of the primary incisor due to caries or trauma may result in healing, with the gingiva overlying the permanent tooth becoming thickened and fibrous. This will provide additional resistance to normal eruption of the permanent tooth.

Treatment in the case of early loss of the primary incisor

In most instances the permanent central incisor will erupt if sufficient space is created (Figures 6a and 6b). However, occasionally an apically repositioned flap is required to encourage the tooth to erupt, and traction must in these circumstances be applied to the tooth. Very occasionally, excision of overlying fibrous tissue is all that is required to allow normal eruption of the permanent tooth [16]. In the case of both the apically repositioned flap and fibrous excision, care must be taken to ensure the unerupted tooth erupts through keratinised mucosa in order to end up with a normal attached gingiva. Once again space may need to be created to facilitate the eruption of the permanent incisor.

Figure 6a **-** Premature loss of the deciduous central incisors has led to space loss. The permanent upper central incisors are identified by the bulging overlying mucosa

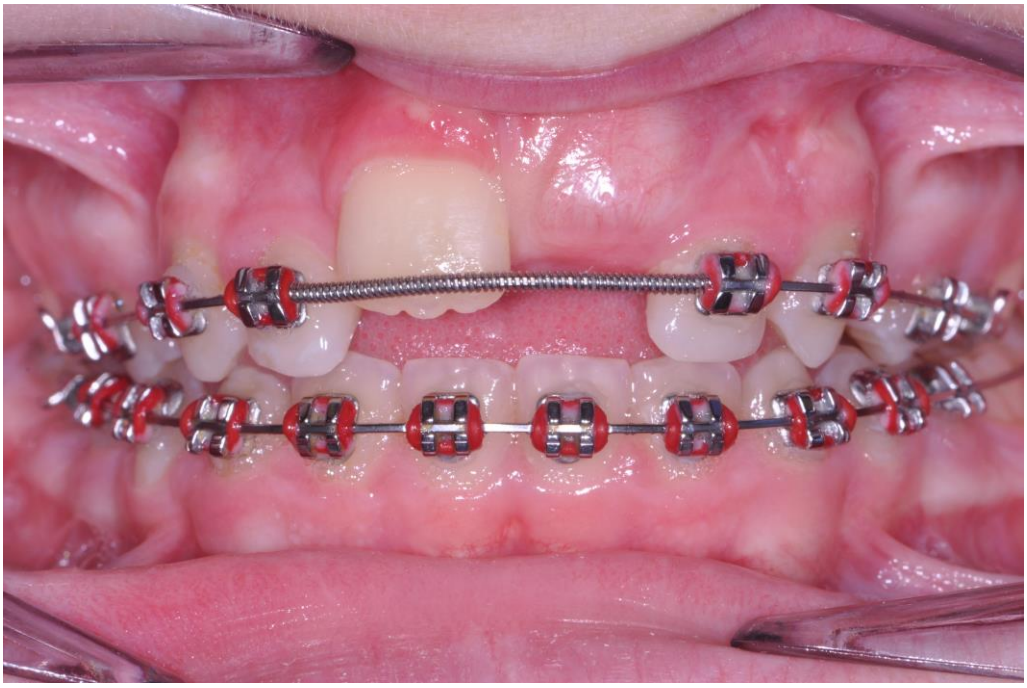

Figure 6b - As space is being created the central incisors are beginning to erupt

3. Dilaceration of the Permanent Central Incisor

Dilaceration can occur as a result of traumatic intrusive injury to the deciduous tooth or it can be developmental in origin. Crown root angulation occurs in 3% of all permanent dentitions [17]. The position and severity of the dilaceration depends on the timing and degree of the intrusion injury in relation to root development of the permanent central incisor. Roughly 20-30% of all dilacerations occur as a result of a traumatic injury to the primary tooth [18], with around 70% being developmental in origin [3].

Treatment in the case of dilaceration

Alignment of the dilacerated central incisor is often possible, but is dependent on the severity and position of the crown root angulation. This can be assessed with a lateral cephalogram [18] or with Cone Beam Computed Tomography (CBCT) [19] (Figure 7). Should alignment be planned, the root apex of the dilacerated tooth will be translated a significant distance and is at high risk of external root resorption [20]. Following alignment, the root apex may perforate the labial or palatal plate of the maxilla and care should be taken not to fully upright the crown in such cases.

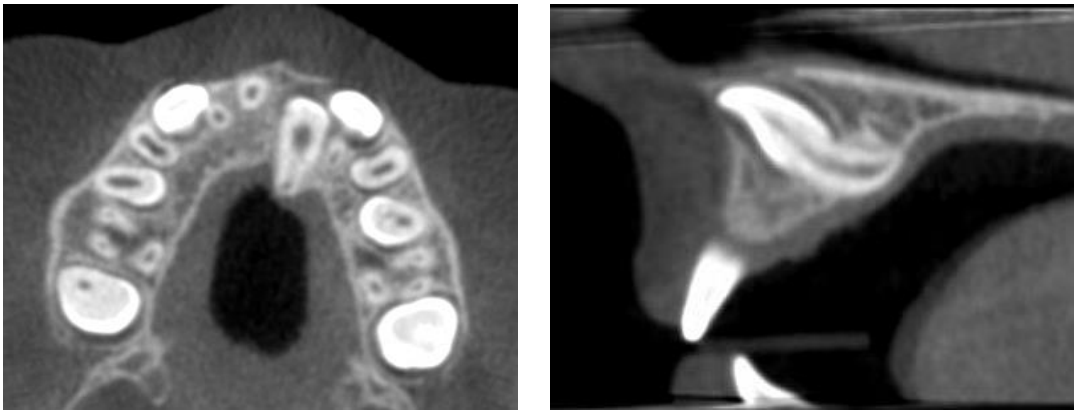

Figure 7 – two views from a CBCT showing a dilacerated upper left central incisor. Full alignment of this tooth could lead to perforation of the labial cortical plate of bone

4. Ankylosis of the permanent central incisor

This can occur as a consequence of either an intrusive injury to the primary or permanent incisor, or as a poor outcome following repositioning of a subluxated incisor or replantation of an avulsed central incisor [21]. The effect on the final outcome will depend at what stage of development the tooth became ankylosed. The younger the patient when the ankylosis occurs the worse the outcome. This is because the face, and in particular the dentoalveolar tissues, will continue to grow vertically. The ankylosed tooth will not move during subsequent growth and instead will appear to submerge (Figure 8).

Figure 8 – The upper right central incisor has been traumatised in the past. Notice how, as a result of ankylosis it is beginning to submerge with continued facial growth.

Treatment of the ankylosed central incisor

The ankylosed tooth will not respond to orthodontic forces and will require either removal with space closure; removal and replacement with either a prostheses or an autotransplanted tooth [22]; or surgical repositioning with a dentoalveolar osteotomy [23]. Decoronation of the tooth can aid bone preservation in the anterior maxilla, with gradual resorption of the root left *in situ* [24, 25]. This may be a treatment choice should a future implant retained prosthesis be considered.

5. Ectopic position of the permanent central incisor

Although rare, it is possible for the upper central incisor to be ectopically positioned. The incisor may be positioned horizontally and high, under the

anterior nasal spine. Ectopia of the tooth germ may be a result of trauma to the primary predecessor or due to abnormal positional development of the follicle [26].

Treatment of the ectopic permanent central incisor

If there is an indication to align the tooth then the same principles should be observed as for the treatment of the dilacerated or any other unerupted permanent incisor. The tooth will require exposure and placement of a chain to allow traction to be placed onto the tooth. It is important that the tooth erupts through attached keratinised gingiva for normal gingival margin development [27, 28]. If the tooth is low then it may be possible to expose using an apically repositioned flap. If the tooth is high, then a closed eruption technique is advisable, with placement of the attachment onto the palatal surface of the central incisor in order to avoid fenestration through the labial mucosa and the creation of a poor gingival margin. The vector of force should also be in a palatal and occlusal direction to prevent early penetration of the mucosa and unfavourable gingival contour.

6. Absence of the permanent central incisor

Developmental absence of the maxillary permanent central incisor is rare and a recent systematic review and meta-analysis calculated the incidence to be <1.2%. Should the permanent central incisor be absent, it is more likely to be due to traumatic injury. These are the most common teeth to be traumatised [29] with avulsion accounting for over 8% of dental trauma in a paediatric emergency department [4]. The most recent Child Dental Health Survey (2013) reported an increased incidence of missing central incisors as a result of trauma, compared to

2003, for both 12 and 15 year olds (2.1/1000 and 1.1/1000 respectively, compared to 0.5/1000 and 0.1/1000 in 2003) [5]. In the absence of an upper central incisor the orthodontic consultation should involve questioning to determine whether there has been any history of previous trauma to either the primary or permanent dentitions.

Treatment of the absent permanent central incisor

When a central incisor is missing a decision has to be made whether to open/ retain the space or to close it. This decision will depend on a number of factors including the amount of space already available and patient attitudes towards prosthetic teeth or complex treatment procedures. If the space is to be maintained or reopened, the permanent central incisor can be replaced with either a prosthetic tooth (a denture, acid etch retained bridge or implant supported crown) or an autotransplanted premolar tooth. If the space is to be closed, the lateral incisor will then need to be camouflaged to mimic the missing central incisor. Autotransplantation and space closure with the lateral incisor will be discussed further.

Autotansplantation

Premolar transplantations have gained popularity in recent years as they provide a natural, physiological replacement in the anterior maxilla and can be placed in a growing individual. This is an especially attractive prospect when teeth will require extraction from other quadrants as part of comprehensive orthodontic treatment. Unlike conventional implant retained restorations, the autotransplanted tooth (often lower second premolars) develops a physiological

and functional periodontal ligament, provided a careful surgical technique is used, and it will respond to subsequent orthodontic forces [22].

Autotransplantation in adolescent patients means patients do not need to wear a removable prosthesis for a prolonged period of time. There are reports of success rates and aesthetic satisfaction equal to and greater than those with implants. [22]. Figure 9 shows the replacement of the upper left central incisor with an autotransplanted premolar prior to reshaping with composite filling material

Figure 9 In this patient the missing upper left central incisor has been replaced by an autotransplanted premolar. The premolar will eventually be reshaped using composite filling material to mimic the missing incisor

Space closure

Space closure may provide the most appropriate treatment for some patients. Camouflage of teeth in the anterior maxilla is most often used when upper lateral incisors are missing and where the canines are of a small size, incisiform in shape and of a good colour to mimic the missing lateral incisor. In the case of

missing central incisors, space closure and camouflage to enlarge the lateral incisor, along with reshaping of the canine and premolar can sometimes result in highly aesthetic outcomes, with a reduced restorative burden for the patient [30]. However, often this is not the case (Figure 10). Not only can the mesiodistal width be a challenge to camouflage in such cases, but so also can the crown length, which can lead to uneven gingival heights between the adjacent central and lateral incisor.

Figure 10 In this case, following the loss of the upper central incisor, the space has been closed with little consideration as to the final aesthetic result

Conclusion

This article has summarised the aetiology and possible treatment options for an unerupted maxillary central incisor. Often, the maxillary central incisor erupts without incident. However, there are occasions where normal eruption does not occur and this can be due to a number of reasons as outlined. Most commonly it

is as a result of trauma to either the primary or permanent dentition. Both the general dental practitioner and orthodontist should be aware of the aetiology and treatment options available to the patient. In some instances early intervention not only increases the chances of successful treatment, but may also simplify treatment. Every case must be judged and assessed individually and treated with a tailored approach.

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